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Scanning Erbium YAG Laser Facial Resurfacing
Dr. Cynthia Weinstein, East Melbourne, Victoria, Australia

Scanning Erbium YAG lasers provide several advantages over other methods of skin rejuvenation. The shallow absorption of the Erbium YAG plus the minimal thermal injury provides great precision for skin resurfacing with laser post operative morbidity. The scanning system is fast, accurate and produces a very homogeneous result. The author has treated 141 patients with superficial and deeper pigmentation, especially those of Asian or Mediterranean origin. Good results were seen in those with periocular, perioral wrinkles and acne scarring. It was possible to continue Erbium YAG treatment with facelifts. The post operative morbidity was less than carbon dioxide laser resurfacing with less erythema, less risk of hyperpigmentation, scarring, and long term hypopigmentation. For this reason, regional resurfacing was possible especially in males and patients undergoing blepharoplasty. The main disadvantages were, bleeding that occurred with deeper resurfacing and the increased number of laser passes needed to obtain the desired depth compared to carbon dioxide lasers. Histologically, new collagen formation was evident with Erbium YAG resurfacing if fluences greater than 15 J/cm2 were used indicating that permanent remodeling of skin did occur.

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HISTOLOGICAL ASPECTS OF SKIN RESURFACING WITH Er:YAG LASER:

Brigita Drnovšek-Olup, University Eye Clinic, Aleksander Rotter, Institute of Pathology, Boris Vedlin, Optotek, Ljubljana, Slovenia

Purpose: Histological study of effects of Er:YAG laser irradiation on skin, using properly selected parameters for skin resurfacing.
Methods: Er:YAG (Fotona Skinlight) laser was used in vivo on human eyelid skin before blepharoplasty. The skin was irradiated with laser energy density 3 J/cm^2 for ablation and immediately after that with energy density 1 J/cm^2, with repetition rate 10-15 Hz for heating of tissue. Skin was excised immediately after the procedure and 3 months later. Skin specimens were histologically examined.
Results: Histology of the skin irradiated with Er:YAG laser (400 mJ, 5 Hz, 300 μs) revealed almost complete epidermal ablation. Narrow layer of thermal effects with coagulative necrosis under the ablated epidermis was in range between 10 μm and 50 μm, depending on the laser energy density parameters. Regaining lost regularity of dermal structures, especially orientation of still preserved collagen and elastic tissue, much more regularly orientated comparing to the disorganisation of the preserved collagen bundles and elastic tissue of the untreated part of the eyelid, was noticed. It could be concluded that this range of laser energy of the Er:YAG laser give rise to some kind of "normalisation" of strength and orientation of the skin structures, lost during the ageing of a skin. The same effects were observed 3 months after the procedure.
Conclusions: Histological study proves that with properly selected Er:YAG laser parameters skin resurfacing can be successfully performed.

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PERIORBITAL SKIN RESURFACING USING AN ERBIUM:YAG 350 μ SEC PULSE: RESULTS IN 20 PATIENTS Robert A. Weiss, Margaret A. Weiss, Sangeeta Marwaha, Allan C. Harrington, Johns Hopkins U School of Medicine, Baltimore, MD.

Preliminary results for regional skin resurfacing using a new modality are presented. Twenty patients, ages 35 – 50, were treated using Er:YAG for regional resurfacing of periorbital rhytides. All treatments were performed using only topical anesthesia. Patients were seen at day 1, 2, 3, 5, 14 and 28. Photographs were obtained prior to application of topical anesthesia and were utilized to judge improvement of rhytides at 2 and 4 weeks post treatment. Results were graded into 4 categories: no improvement, mild (grade 1- up to 25%), moderate (grade 2 - 25-50%), good (grade 3 -50 – 75% or excellent (grade 4 - 75 – 100%). All side effects were noted. Treatment parameters were two – three passes at 1.5 J/cm2 using a 3mm collimated handpiece.

Results at 2 weeks were a mean of 2.5 (between moderate and good – range 1 –4)). At 4 weeks further improvement was noted with a mean of 3 (good results) (range 2 –4). At least slight erythema was noted in 80% at week 2 but diminished to 5% at week 4. Side effects included 2 cases of acneiform folliculitis thought to be due to continuation of occlusive topicals beyond 4 days. Periorbital edema was seen in 16 out of 20 patients at day 1, clearing by day 3. Re-epithelialization occurred by day 4 post-op. All patients tolerated the treatment using topical anesthesia alone. Er:YAG periorbital resurfacing is a safe and effective modality which achieves substantial therapeutic effect. Erythema fades quickly

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EXTENDED CLINICAL EXPERIENCE WITH ERBIUM:YAG CUTANEOUS LASER RESURFACING

Tina S. Alster, M.D., Washington Institute of Dermatologic Laser Surgery, Washington, D.C.

PURPOSE: To report on the clinical results obtained from erbium:YAG laser resurfacing of more than 150 patients with photodamaged and scarred skin.

METHODS: All patients who had undergone cutaneous laser resurfacing using an erbium:YAG laser system were included in the study. All laser procedures were performed by the same experienced laser operator. Clinical assessments of sequential photographs obtained at baseline, 0.5, 1, 2, 4, 12, and 24 weeks were made independently by two blinded assessors. Reepithelialization times and postoperative side effects and/or complications were recorded. Melanin and erythema spectrometry measurements were taken when possible.

RESULTS: The most favorable results were observed in patients with mildly photodamaged skin. In particular, mild to moderate facial rhytides, mild atrophic scars, and epidermal melasma showed significant clinical improvement. Subjects with moderate to severe atrophic scars and rhytides with jowling did not improve to as great an extent. Degree of erythema corresponded directly with the number of laser passes delivered, with more prolonged and intense erythema evident in moderate to severely photodamaged and scarred skin which required additional intraoperative laser passes. No

hypertrophic scarring, infections, or long-term pigmentary alterations were observed.

CONCLUSION: Erbium:YAG laser resurfacing provides significant clinical improvement with rapid postoperative healing in patients with mild to moderate photoaging and scarring.

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TREATMENT OF FACIAL SKIN USING COMBINATIONS OF CO_2, Q-SWITCHED ALEXANDRITE, AND/OR FLASHLAMP-PUMPED DYE AND/OR ERBIUM LASERS IN THE SAME TREATMENT SESSION. **Richard E. Fitzpatrick, Mitchel P. Goldman, Woraphong Manuskiatti. San Diego, CA**

Purpose: Many patients who seek facial CO_2 laser resurfacing for improvement of photoaging are also concerned with "dark circles" under their eyes and/or "broken vessels" on their faces. CO_2 laser resurfacing alone provides limited improvements of these problems. The objective of this study is to demonstrate conjunctive therapeutic effects of the CO_2, Q-switched alexandrite, erbium and/or flashlamp-pumped pulsed dye lasers on facial skin treatments.

Method: Patients with facial telangiectasias were treated with the flashlamp-pumped pulse dye laser immediately prior to CO_2 laser resurfacing. Patients with peri-orbital hyperpigmentation were treated with the Q-switched alexandrite laser immediately following use of the pulsed CO_2. Patients having sharply defined acne scars or deep photodamage were treated with the erbium laser following use of the CO_2 laser. All patients had peripheral feathering performed with the erbium laser.

Results: In addition to significant improvement of the wrinkle scores from the CO_2 laser resurfacing, patients demonstrated more than 75% improvement of peri-orbital hyperpigmentation. All patients who presented with facial telangiectasias showed 100% improvement. All deep photodamage responded better than CO_2 laser treatment alone. All feathering was more uniform with a more subtle transition to non-treated skin.

Conclusions: For patients who presented with multiple cosmetic complaints, combined treatments using appropriate lasers offer excellent therapeutic outcome.

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COMBINED LASER RESURFACING WITH THE ULTRA PULSE CO_2 LASER FOLLOWED BY THE ERBIUM:YAG LASER

Mitchel P. Goldman, Richard E. Fitzpatrick, Yardy Tse, Woraphong Manuskiatti; La Jolla, CA

The purpose of the study is to decrease the inflammation secondary to non-specific thermal damage. Ten patients were treated with the UltraPulse CO_2 laser on the entire face. Two passes were given to the entire face. One side of the face was then treated with a third pass of the UltraPulse CO_2 laser, the other side of the face was treated with two additional passes with the Erbium:YAG laser. Patients were followed up to determine the incidence of pigmentation, erythema, and improvement in their wrinkling score. Preliminary analysis of the results suggests a decreased incidence of erythema and pigmentation with similar efficacy in wrinkle score. Therefore, use of the Erbium:YAG laser following the UltraPulse CO_2 laser may be an optimal method for decreasing adverse sequelae from laser resurfacing.

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THE ERBIUM: YAG LASER: A REVIEW AND FOLLOW-UP REPORT ON RESURFACING OF THE FACE, NECK, AND HANDS.

David H. McDaniel, Keith Ash, Jeff Lord, John Newman, and Mark Zukowski. Laser Center of Virginia, Eastern Virginia Medical School and Naval Medical Center Portsmouth, Virginia.

The purpose of this study was to evaluate a mid-infrared pulsed Erbium: YAG laser prospectively to determine its clinical efficacy for resurfacing of the face, neck, and hands. Postoperative changes and recovery period were also evaluated. A total of 31 patients were evaluated on a prospective basis with Er:YAG laser resurfacing. Crow's feet and upper lip rhytids were treated with a 5 mm circular spot size at 1 Joule, 5 J/cm^2 with 4 or 5 passes. Neck and hands were treated with a 5 mm circular spot size at 500 millijoules, 2.5 J/cm^2, with 2 or 3 passes (300 millijoules used for feathering). Treatments were administered at one to 10 Hertz with a 10-30% overlap, freehand technique. Postoperative care utilized a dilute acetic acid solution and white petrolatum. Six month follow-up data currently complete on 21 patients. Post treatment crusting or scabbing lasted an average of 2.7 days, pain an average of 3 days, erythema an average of 5.2 days, and swelling an average of 3 days. Blinded subjective grading was performed 2 and 6 months Postoperatively. This grading at six months revealed a 62% combined improvement from all areas. The appearance of crow's fee was improved by 69%, upper lip, 57%, dorsal hand, 50%, and neck, 60%. Overall the Er:YAG laser consistently produced reduction of rhytids and improvement in the appearance of sun-damaged skin. The times for reepithelialization and duration of erythema were strikingly shorter than typically observed with CO^2 laser resurfacing. This report will detail the complete 6 month study data a subset of 9 and 12 month follow-up, report additional non study experience on neck and hand resurfacing, and review Er:YAG laser technology.

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REMOVAL OF FACIAL RHYTIDES AND SUPERFICIAL ACNE SCARS COMPARING THE PENDULASER SYSTEM WITH THREE OTHER CARBON DIOXIDE LASERS.

LC Lucchina, PL Leuenberger, JM Grevelink, Dermatology Laser Center, Massachusetts General Hospital, Boston, MA.

Many established methods exist for improving the appearance of photodamaged or scarred skin. Presently, advances in laser resurfacing technology allow for tissue ablation with limited thermal damage. The PenduLaser is a compact 15 watt CO_2 laser with an OptoScan™ scanning device. We treated fifteen subjects with periorbital or perioral rhytides or facial acne scars with the PenduLaser system. The remaining five subjects were treated with either the UltraPulse, TruPulse or FeatherTouch systems. Serial clinical and photographic evaluations as well as biopsies of treated areas were done. All patients experienced clinical improvement throughout the study.

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CRYOGEN SPRAY COOLING IN CONJUNCTION WITH 532 NM LASER IRRADIATION OF PORT WINE STAINS

B. Anvari[1,2], B.Ver Steeg[2], T. E. Milner[1], B. S. Tanenbaum[2], and J. S. Nelson[1]

[1] Beckman Laser Institute and Medical Clinic, University of California, Irvine, CA

[2]Department of Engineering, Harvey Mudd College, Claremont, CA

Purpose: To investigate the effectiveness of cryogen spray cooling in protecting the epidermis from 532 nm laser induced thermal injury during treatment of port wine stain (PWS) birthmarks.

Methods: Selected PWS sites of volunteers were irradiated with a Nd:YAG laser (wavelength = 532 nm, pulse duration = 2-10 ms, spot size =3 mm, incident fluence = 5-15 J/cm^2). Millisecond R-134A (boiling point ≈ - 26 °C) spurts were sprayed onto the skin surface immediately prior to laser irradiation. Infrared emission from skin was collected by an InSb focal plane array to measure the temporal radiometric temperature change. An algorithm was used to compute the spatial temperature distribution within skin from the temporal infrared measurements.

Results: Laser induced temperature increase due to epidermal melanin absorption was consistently maintained below 60 °C when the skin surface was sprayed with a short cryogen spurt immediately prior to irradiation. As computed by the algorithm, laser induced temperature distribution within blood vessels was not affected by the cryogen spurt sprayed onto the skin surface.

Conclusions: Successful 532 nm laser induced blanching of PWS without thermal injury to the epidermis can be obtained when spraying short cryogen spurts onto the skin surface.

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A COMPARISON IN THE TREATMENT OF LEG AND FACIAL TELANGIECTASIAS WITH THE PHOTODERM® VL SYSTEM USING LONG AND SHORT PULSE DURATIONS

Stanley J. Kovak, M.D. The Midwest Dermatologic Laser & Vein Center, Oak Brook, Illinois.

PURPOSE: The objective of this study was to compare the clinical effectiveness in treating leg and facial telangiectasias using the PhotoDerm® VL system with relatively short and long pulse durations.

METHODS: Twenty-five patients (>18 yrs) with facial and leg telangiectasias were included in the study. The PhotoDerm® VL system at default settings with relatively short pulse durations of less than 4 msecs and variable fluences was used to treat facial and leg telangiectasias ranging in size from 0.1mm to greater than 1 mm in diameter. Similarly, the PhotoDerm® VL system was then used to treat facial and leg telangiectasias using relatively long pulse durations of greater than 10 msecs and variable fluences. Each patient received multiple treatment sessions at 3-4 week intervals. Sequential and clinical graded scores were obtained preoperatively and at four week intervals post-operatively.

RESULTS: Clinical improvement was observed in all facial and leg telangiectasias with either short or long pulse durations; however, significantly improved results were observed with the longer pulse durations. An increase in side effects, especially hyperpigmentation, was also observed as fluences increased with the longer pulse durations.

CONCLUSION: Facial and leg telangiectasias can be improved with the PhotoDerm® VL system; however long pulse duration treatments significantly improve the results obtained.

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LONG-PULSED 532nm LASER TREATMENT OF PORT WINE STAINS

Emil A. Tanghetti, M.D., Robert M. Adrian, M.D., Center for Laser Surgery, Sacramento, CA, Washington, D.C.

Port wine stains remain a challenge to the laser surgeon. 20 patients with port wine stains were treated with a long-pulsed 532nm Nd:YAG laser (Versapulse^R, Coherent Medical, Palo Alto, CA). Fluences of 9.5-16J/cm^2 with a 3 or 4mm spot, a 10msec. pulse, and a water-cooled chill tip at 4-5.5° C were used. The affected areas were treated with 1-3 passes at each session. 1-4 treatments were performed over a period of up to one year. Patients with pink lesions showed a gradual lightening much as has been observed with pulsed-dye laser treatments. Surprisingly, a group of patients with older lesions which were darker and almost papular showed remarkable improvement. Some of these were resistant to conventional pulsed-dye laser therapy. The unique chill tip, in firm contact with the skin, allows the delivered energy to remain relatively confined to the targeted, abnormal blood vessels and permits multiple low-peak temperature heating cycles in the form of multiple passes. The pressure of this chill tip might also compress the target and improve the efficacy of this laser. This preliminary study suggests the utility of the Versapulse^R laser in the treatment of port wine stains.

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TRANSCUTANEOUS AND INTERSTITIAL LASER TREATMENT OF VASCULAR DISORDERS

Philipp, C., Urban, P., Müller U., Poetke, M., Algermissen, B., J., Berlien, H.-P.

Krankenhaus Neukölln, Dept. Lasermedicine, Berlin, Germany

During the last 13 years several laser techniques have been invented and evaluated for the treatment of congenital and aquired vascular disorders by our group. Using flashlamp pumped dye lasers, argon-ion lasers and Nd:YAG-lasers, the application techniques are modified according to the type of disease, vessel size and perfusion respectively, from simple transcutaneous irradiation, laser treatment with several types of superficial cooling techniques to interstitial applications guided by duplex sonography.

Cooling techniques:

A cooling chamber provides skin protection and helps to minimize the use of anesthesia in the treatment of PWS with a flashlamp pumped dye laser (585nm). A flexible membran, facing the skin of the patient, provides close contact and good thermal conduction and the possibility of compression. The temperature and flow of the cooling fluid can be varied. The same cooling chamber is used with the Nd:YAG-laser for the scarless removal of leg teleangiectasias.

A permanent ice cube cooling during irradiation with a Nd:YAG-laser (1064nm) provides a safe protection of the skin and is most suitable for the treatment of hemangiomas with combined subcutaneous and cutaneous portions. Compression can be used to enhance the depth of the laser effect up to two centimeters.

Interstitial laser application:

The interstitial or intravascular application is suitable for large or only subcutaneous hemangiomas, venous vascular malformations and to

occlude small shunt vessels wich cannot be embolized. The puncture with an Abbocath® G16 and irradiation with a Nd:YAG-laser are controlled by the means of duplex sonography.
Results:
The average number of treatments vary from 1.9 in hemangiomas to 2.7 in av-malformations with a total of more than 5000 applications.

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Nd:YAG Laser and the Treatment of Large Vessel Disorder
Milton Waner, James Y. Suen, Arkansas Children's Hospital, University of Arkansas for Medical Sciences, Little Rock, AR

The continuous wave Nd:YAG laser remains useful for the treatment of large vessel (>500u) disorders. At exposure of times of between 0.05 and 0.5 seconds, this laser can be used in the free-beam mode with a 600u flat cut fiber to treat ectatic grade V portwine stains as well as compound or superficial venous malformations. Up to 4mm of coagulation can be expected at these parameters. A retrospective review of 40 patients with venous malformations or advanced (grade V) portwine stains, treated with a Nd:YAG laser was undertaken. All patients responded well and, at exposure times of 0.1s or less transcutaneous applications were safe. Punctate atrophic scarring was evident in 10% of patients however this improved over 6 months. This complication became more prevalent at longer exposure times during the treatment of submucosal lesions. In view of the dramatic improvement seen with these patients and the lack of alternatives this device remains our workhorse laser for the treatment of large vessel disorder.

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FLUENCE AND DEBRIDEMENT EFFECTS ON CUTANEOUS CO_2 LASER RESURFACING. Noah Kawika Weisberg, Timothy Kuo, Berhooz Torkian, Lou Reinisch, Darrel L. Ellis, Vanderbilt University and Nashville VA Medical Centers, Nashville, TN.
Methods are needed to optimize and compare the clinical efficacy and side effect profiles of various CO_2 resurfacing lasers. We studied the clinical effects of varying levels of fluence and aggressiveness of debridement on tissue shrinkage and histological thermal damage. *In vitro* human skin samples (n>140, 10 patients) or *in vivo* porcine skin samples (n>40, 2 animals) received up to 5 passes with scanned or short pulsed CO_2 resurfacing lasers. Fluences ranging from 2.2 - 17.6 J/cm^2 (scanning) and 1.1 - 5.6 J/cm^2 (short pulsed) were used to determine each laser's threshold energy for clinical effect. Amount of debridement between passes was studied as an independent variable. Tissue shrinkage was measured as linear change in distance of the treated tissue utilizing digital photography. Histological changes were evaluated with microscopic morphometry. *In vitro* tissue shrinkage independent of fluence was seen with both laser delivery systems above a threshold fluence level of 3 J/cm^2. Histologically measured depths of thermal necrosis of 76 μm for the scanned and 23 μm for the pulsed laser were observed above the threshold fluence. More aggressive debridement of the tissue resulted in increased shrinkage per pass of the laser for any given fluence, and decreased the threshold fluence. *In vivo* porcine experiments confirmed the *in vitro* results, although slightly higher threshold fluence levels and slightly less shrinkage per pass were observed. Our methods allowed comparison of different resurfacing lasers' acute effects. We found equivalent laser tissue effects utilizing lower energy levels than are currently accepted clinically. This suggests the morbidity of CO_2 laser resurfacing may be minimized by lowering levels of tissue input energy and controlling for tissue debridement. Supported by Medical Free Electron Laser ONR grant N0001-494-11023 and NIH grant P30 AR41943.

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HISTOLOGIC ANALYSIS OF THE THERMAL EFFECTS OF THE SUPERPULSED CO_2 LASER AND THE ERBIUM:YAG LASER ON EPIDERMAL AND DERMAL STRUCTURES: AN *IN VIVO* MODEL
David S. Utley and R. James Koch / Stanford University Medical Center
Purpose: A human facial skin *in vivo* model was used to compare the histopathologic effects of the superpulsed CO_2 laser (10.6 μm) and the Erbium:YAG laser (2.94 μm) for the application of skin resurfacing. Parameters evaluated include depth of vaporization per pass, extent of collateral thermal injury, alteration in elastotic dermal material, dermal injury, neo-collagen formation, collagen shrinkage, and inflammatory changes.
Methods: Ten patients underwent laser treatment to 2 sites in the left preauricular region 7 days prior to rhytidectomy. One site (6 mm^2) had 3 passes with the CO2 laser (5 J/cm^2); while the second site had 6 passes with the Erbium:YAG (1.7 J/cm^2). The right preauricular area was treated with the lasers in an identical manner 1 hour prior to the rhytidectomy procedure. Skin excision during rhytidectomy encompassed the treated skin. An untreated control specimen was obtained. An additional specimen (6 mm by 12 mm) of normal skin was removed and treated with the laser *ex vivo* at 2 sites using the same settings as preoperatively. Histopathologic evaluation was performed.
Results: Superpulsed CO_2 laser vaporized 60-100 μm per pass with 20-80 μm of collateral thermal damage. Significant dermal heating effects were seen, as well as collagen shrinkage and inflammatory changes. Dermal elastotic material was reduced. Erbium:YAG laser vaporized 25-40 μm per pass with <10 μm of collateral thermal damage. No significant collagen shrinkage or inflammation were seen.
Conclusions: Superpulsed CO_2 laser results in deeper thermal penetration per pass, more inflammatory changes, alterations in elastotic material, and stimulation of collagen formation. Erbium:YAG, with its higher absorption coefficient for water (7700 cm^{-1}), vaporizes a thinner layer of tissue per pass and results in less collateral thermal damage. Erbium:YAG causes less inflammation and collagen shrinkage. There may be an application for combined modality treatment in laser skin resurfacing utilizing the superpulsed CO_2 laser followed by Erbium:YAG to selectively remove the thermally injured layers, or, conversely utilizing the Erbium:YAG first for selective vaporization followed by the superpulsed CO_2 laser at a lower setting to achieve dermal heating for the desired collagen changes.

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COMPARISON OF TISSUE EFFECTS OF CARBON DIOXIDE, ERBIUM:YAG AND NOVEL INFRARED LASERS FOR SKIN RESURFACING

Kauvar, ANB, Grossman, MC, Bernstein, LJ, Kovacs, SO, Quintana, AT, Geronemus RG
Laser and Skin Surgery Center of New York

Kauvar et al have developed a reliable *in vivo* model to evaluate the histopathological effects of resurfacing lasers on skin. These studies have been valuable in comparing resurfacing lasers as well as establishing treatment guidelines for each system. A comparative analysis of CO_2, Erbium:YAG and other resurfacing lasers will be presented.
Single and multiple passes were performed with each laser system utilizing clinically relevant treatment parameters, on the redundant portion of donor skin to be used for full thickness skin grafting, or tissue to be excised during a rhytidectomy or abdominalplasty.

The depths of ablation and residual thermal damage achieved with single or multiple passes with each laser system are discussed. The clinical relevance of pulse and scan stacking with CO_2 and Erbium:YAG lasers is discussed.
Histologic analysis of the immediate tissue effects of resurfacing lasers is helpful in establishing treatment guidelines for these lasers.

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A CLINICAL AND HISTOLOGIC COMPARISON OF ERBIUM-YAG AND PULSED CARBON DIOXIDE LASERS IN THE TREATMENT OF FACIAL RHYTIDS

Robert M. Adrian, Georgetown University Medical School, Center for Laser Surgery, Washington, DC

The advent of new pulsed and flash-scanned high energy carbon dioxide lasers has revolutionized the treatment of facial rhytids, sun-damaged skin and acne scars. Carbon dioxide lasers are capable of relatively precise coagulative tissue effects which result in a postoperative therma wound. Re-epithelialization occurs within 10-14 days, however, the skin remains erythematous for weeks to months with pigmentation changes and scarring among the more significant side effects. Recently mid-infrared pulsed Erbium YAG lasers have been introduced with claims of efficacy regarding the treatment of rhytids. At a wavelength of 2,940 nanometers, Erbium-YAG has approximately ten times more water absorption than that of CO^2 laser energy. Rathe than tissue coagulation, this wavelength provides true tissue ablation with little residual thermal damage. In an attempt to determine the role of Erbium-YAG lasers in the treatment of facial rhytids and delineate any comparative advantages with regard to pain, erythema, healing time and efficacy, we entered twenty patients with facial rhytids in a bilateral comparison study. Patients were treated using an UltraPulse^R CO^2 laser (Coherent Medical, Palo Alto, CA) on one side and a Pulsed Erbium-YAG laser (Continuum Biomedical, Dublin, CA) on the opposite side. Bilateral histologic studies were also performed. The results of our study support the role of Erbium-YAG in the treatment of fine facial rhytids and sun-damaged facial skin. Of interest was the fact that when the Erbium-YAG laser was used to achieve wrinkle removal with multiple passes, there was less clear-cut advantages with regard to pain, erythema and healing time when compared to the side treated with the CO^2 laser. The results of this study will be presented and expanded.

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NONABLATIVE LASER TREATMENT OF FACIAL RHYTIDES: UNITED STATES PHASE II CLINICAL STUDY

K. Kelly[1], J.S. Nelson[1], T.E. Milner[1], B. Anvari[1], G.P. Lask[2], P.K. Lee[2], M. Seyfzadeh[2], R. Geronemus[3], L.J. Bernstein[3], W.F. Coulson[4], J. O'Connell[4], R.G. Wheeland[5], B. Sand[6], M. Sand[6], R. Menefee[6], J. Baumgardner[6], D.R. Hennings[7], M.J. Berry[7]
[1]*Beckman Laser Institute and Medical Clinic, University of California, Irvine, CA* [2]*Encino, CA* [3]*Laser and Skin Surgery Center, New York, NY* [4]*UCLA, Los Angeles, CA* [5]*Palomar Medical Products, Lexington, MA* [6]*Laser Aesthetics, Inc., Calabasas, CA* [7]*New Star Lasers, Auburn, CA*

Purpose: To evaluate the safety and effectiveness of nonablative laser treatment of facial rhytides in a Phase II clinical study.

Methods: Patient facial rhytides were treated with a New Star Model 130 laser system using three sequential passes of laser energy, a pulse waveform of three 200 μs duration laser pulses at 100 Hz pulse repetition frequency, and pulse radiant exposures (F_n) extending up to 12 J/cm^2. Laser energy was delivered by a fiberoptic handpiece into a 5 mm diameter spot, which was moved manually from spot to spot. A dynamic cooling technique was used to pre-cool skin sites immediately before laser treatment to produce selective subsurface skin heating without epidermal damage. Calibrated photography and profilometry measurements were used to quantitate the reduction of facial rhytides.

Results: Immediately post-treatment, mild edema and erythema appeared in treated skin areas; these side effects typically resolved within 2 days after treatment. At 1 month and longer post-treatment, the severity of facial rhytides was reduced without complications such as persistent erythema and dyspigmentation.

Conclusions: Nonablative laser treatment of facial rhytides may be a useful alternative to ablative laser skin resurfacing, particularly for patients with light to moderate wrinkle severity.

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LASER ASSISTED BLEPHAROPLASTY

Richard O. Gregory, Celebration Laser Center, Celebration, FL

The author has performed over 150 blepharoplasties using the Ultrapulse laser. Using the laser has obviated the need for using the electrocautery and the scalpel. Furthermore, the skin incision of the lower eyelid has been abandoned in favor of the eyelid skin resurfacing. Reduction of upper eyelid skin excised has approximated 30% with resurfacing the skin prior to the laser skin excision and has resulted in the improved appearance nearly eliminating the resultant scar when compared to the scalpel excision. Reduction in operating time, complications and improved results justify the laser assisted blepharoplasty. The video will demonstrate the techniques used by the author for this procedure.

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Comparative study of the treatment of DLE-lesions with flashlamp-pumped dye laser, argon laser and copper laser

B. Algermissen[1], C. Philipp[1], G. Kolde[2], B. M. Henz[2], W. Sterry[2] and H.-P. Berlien[1].
[1]Dept. of Lasermedicine, Krankenhaus Neukölln, Rudower Str. 48, D-12313 Berlin, Germany
[2]Dep. of Dermatology, Charité, Humboldt-University of Berlin, Germany

Discoid lupus erythematosus lesions can either be the clinical manifestation of systemic lupus erythematosus or represent an independent entity. Both local and systemic treatments seem to offer only a temporary improvement for the long lasting erythematous and hyperkeratotic lesions. We demonstrated in a former study the strong expression of adhesion molecules like ELAM in DLE-lesions but not in normal skin. These are necessary for the recruitment of activated T-cells out of the peripheral blood. Under the hypothesis that the selective destruction or coagulation of these vessels would lead to a modulation of the inflammatory network, we treated DLE-lesions with argon, copper and flashlamp-pumped dye lasers and compared the improvements to before laser therapy. The treatment parameters of all lasers used were comparable to the parameters used for the treatment of portwine stains. Independent of the laser type, we obtained a complete to partial regression of the DLE-lesions in 31 out of 32 patients (11 with argon, 13 with copper and 7 with flashlamp pumped dye laser). In cases of complete regression, we have observed no clinical

reappearance in up to 3 years of observation. The copper laser induced regression after only 2 to 4 treatments, but with the argon and flashlamp-pumped dye lasers more treatments were necessary. Nevertheless, the flashlamp-pumped dye laser was better accepted by the patients because of less side effects and pain under treatment. In this study we present the first report on the effective treatment of DLE-lesions using various types of lasers. Furthermore, our data suggest that with a suitable laser the modulation of the inflammatory network is practicable and can lead to a regression of local lesions of autoimmune diseases.

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LASER ASSISTED HAIR REMOVAL USING THE CYNASURE LONG PULSE ALEXANDRITE LASER. Tom Y. Woo, Gwen Molnar, Calgary, Alberta, Canada.

The efficacy of the long pulse alexandrite laser (Cynosure) in removing hair was evaluated in a clinical setting with parameters of skin types and subtyped by color of hair. During a period of 6 months, a total of 392 patients of varying skin types were treated with one pass and with varying fluences. Hair counts and photographs were performed at pre-treatment intervals and again after one month immediately prior to the second treatment. For Fitzpatrick's skin types I to III, a 20 msec pulse width was used in conjunction with a 7 mm handpiece at fluences of 30 J/cm^2. Those with skin types IV-V were treated with a 20 msec pulse width using a 10 mm handpiece at 12 J/cm^2. Calculated reduction of visible terminal and vellus hair counts at one month follow-up for skin types I-III were a 44% decrease for those individuals with brown hair and a 52% reduction in those with black hair. Those in the category of skin type IV-V all had black hair and experienced a reduction after one month of 58%. The incidences of side effects for all groups were minimal. Patients tolerated the procedure well. The long pulse alexandrite laser was effective in the short-term removal of hair in skin types 1-V with an acceptable response rate and minimal side effects.

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LONG PULSED RUBY LASER FOR HAIR REMOVAL: COMPARISON BETWEEN DIFFERENT SPOT SIZES, TEMPERATURES AND INTERVAL BETWEEN FIRST AND SECOND TREATMENT. Valeria Duque, Christine C. Dierickx, David Lin, William A. Farinelli, R. Rox Anderson. Wellman Laboratories, Boston.

Three studies were performed to determine the influence of spot size, temperature and time between treatments on the efficacy of long pulsed ruby laser for hair removal. 12 subjects for each study volunteered.

The efficacy was compared of 3 spot sizes (7,10 and 15 mm), using varying fluences (20 to 100 J/cm^2) in a single treatment session.

The influence of cooling (10°C) and heating (40°C) of the skin just before treatment, using varying fluences (20 to 50J/cm^2) was examined. Only a single treatment was given.

The influence of the time between the first and second treatment was also studied. Two treatments with a fixed interval of 1 month between treatments was compared with two treatments in which the second treatment was given when the hair started to grow back.

Hair counts were obtained prior to treatment and at 1,3 and 6 months post laser treatment using digital images obtained with a CCD camera. Preliminary results suggest that small spot sizes require higher fluences for hair removal, that cooling minimizes acute side effects and pain, and that re-treatment is more effective when performed during early hair regrowth. However, follow-up continues at the time this abstract was written.

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THE LONG PULSED ALEXANDRITE LASER: A PRELIMINARY REPORT ON HAIR REMOVAL OF THE UPPER LIP, LEG, BACK AND BIKINI REGION.

David McDaniel, Keith Ash, Jeff Lord, John Newman, Mark Zukowski. Laser Center of Virginia, Eastern Virginia Medical School and Naval Medical Center Portsmouth, Virginia.

The long pulsed infrared laser (LPIR) has recently been approved for the use of hair removal from various body locations. Long term data on its efficacy and duration of hairlessness continue to be assessed. The purpose of this study was to prospectively evaluate the long term efficacy and side effects of the LPIR laser for hair reduction at various body locations. A total of 31 anatomic sites on 22 patients were evaluated on a prospective basis with the LPIR long pulsed Alexandrite laser to assess hair removal (17 upper lips, 9 legs, 3 bikini regions and 2 backs). Treatment parameters were established using a 10 mm spot size at 20 J/cm^2 and varying pulse durations of 5, 10, and 20 ms utilizing a single pulse technique without cooling. Objective patient improvement and objective, blinded graded improvement was assessed at 1,2,3 and 6 months, respectively. Patients subjectively reported on average 55%, 60%, 67% and 71% improvement in the regions of the lip, back, bikini, and leg respectively at 3 months. Blinded grading noted that at 6 months the reduction in hair removal varied with the pulse duration for all regions assessed. The effects of multiple treatments and relationship to anagen phase hair growth and Fitzpatrick skin types will be presented as well as additional long term data and effects of newer treatment protocols. Conclusion: The long pulsed Alexandrite laser is safe and effective in reducing hair growth long term and its efficacy varies with respect to the location treated.

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The Safety And Efficacy Of The Long Pulse Alexandrite Laser For Hair Removal In Various Skin Types

Vic Narurkar MD, UC Davis Laser Center; H Michael Miller MD and Robert Seltzer MD, Advanced Laser Center, Pasadena, CA

Laser assisted hair removal poses several challenges in pigmented skin (Fitzpatrick skin types higher than III). due to unwanted melanocyte damage and risks of changes in pigmentation. We examined the safety and efficacy of the long pulse Alexandrite laser (LPIR, 755nm, Cynosure Inc.) with a variable pulse duration on all Fitzpatrick skin types. Sixty patients were enrolled in the study. Laser epilation was performed at identical sites in all patients. Clinical evaluation (hair counts, photography, and subjectve evaluation) was performed at 6 weeks, 3 months, and 6 month intervals thereafter.

Pulse durations of 5 msec and 10msec were less effective than 20msec for all skin types. Fluences less

than 15 to 20 joules were better tolerated in darker skin types (type IVand higher), but additional treatments were required to achieve the same end-point. Higher fluences in darker skin types produced blistering and transient pigmentary change.

We conclude that the long pulse Alexandrite laser (LPIR, 755nm, Cynosure Inc) is safe and effective in the removal of hair in all skin types. Longer pulse durations (20 msec) are more effective in all skin types. Lower fluences (8 to 15 joules/cm2) are required for the avoidance of pigmentary complications in darker skin types. Additional histologic studies to compare fluence and pulse duration correlation are currently being conducted

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HAIR REMOVAL WITH A NON-COHERENT FILTERED FLASHLAMP PULSED LIGHT SOURCE Robert A. Weiss, Margaret A. Weiss, Sangeeta Marwaha, Allan C. Harrington, Johns Hopkins U School of Medicine, Baltimore, MD

This study was undertaken to evaluate the effects on hair removal of a non-coherent filtered flashlamp in various body locations. Twenty-eight sites on twenty-three patients skin types I-III were randomly enrolled for hair removal using a single treatment of intense pulsed light. Parameters included a 2.8msec to 3.0 msec pulse, 615 or 645nm cutoff filter, and thermal relaxation times of 30 msec between triple pulse delivery of 40 – 42 J/cm2. Hair counts were obtained by averaging three one cm squared areas on a template placed over the skin. Patients were followed by repeat hair counts and photographs obtained at 2,4,8 and 12 weeks.

For the single treatment protocol results indicated immediate hair clearance of 31% followed by reduction of hair counts yielding 54% reduction at 2 weeks, 56% reduction at 4 weeks, 56% reduction at 8 weeks and 63% reduction at 12 weeks. A double treatment protocol one month apart on 40 sites demonstrated similar results. Side effects included a 92% rate of mild erythema lasting for several hours, an 18% incidence of an urticarial edema with 1 site developing a vesicle which healed with no sequelae. All patients reported far less pain than electrolysis. We concluded that a IPLS is safe and effective for hair removal. Hair density is reduced by approximately 60% at 3 month follow-up. Side effects are minimal. No site preparation is necessary.

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EFFICACY OF MULTIPLE HAIR REMOVAL SESSIONS USING THE Q-SWITCHED Nd:YAG, LONG-PULSED RUBY, AND LONG PULSED ALEXANDRITE LASER SYSTEMS

Christopher A. Nanni, M.D. and Tina S. Alster, M.D., Washington Institute of Dermatologic Laser Surgery, Washington, D.C.

PURPOSE: To summarize the clinical results of multiple laser-assisted hair removal treatments using three FDA-approved laser systems.

METHODS: A retrospective chart review of patients undergoing hair removal using either a carbon-assisted Q-switched Nd:YAG laser, long-pulsed ruby laser with a cooling handpiece, or long-pulsed alexandrite laser was performed in order to determine the efficacy of hair removal after three or more laser treatments. Chart review, photographic analysis, and patient questionnaires were utilized in order to document percent reduction in hair regrowth and overall patient satisfaction. Skin types, anatomic locations treated, energy fluences, and treatment protocols are reported.

RESULTS: Patients treated with the carbon-assisted Q-switched Nd:YAG laser experienced the greatest degree of hair regrowth and were least satisfied with treatment outcome. The long-pulsed ruby and alexandrite laser systems demonstrated equivalent hair removal efficacy and a high degree of patient satisfaction, especially in facial, inguinal, and axillary regions. Successive laser treatments resulted in a greater degree of prolonged hair growth reduction compared to individual treatment sessions.

CONCLUSIONS: Multiple laser-assisted hair removal treatments are more effective in decreasing hair regrowth and increasing patient satisfaction than are single laser treatment sessions. The long-pulsed ruby and alexandrite lasers produced greater hair reduction than the carbon-assisted Q-switched Nd:YAG laser; however, long-term epilation with any laser system requires multiple treatments.

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TREATMENT OF LEG TELANGIECTASIA BY A PULSED, INFRARED LASER SYSTEM: Christine C. Dierickx, Valeria Duque, Rox Anderson. Wellman Laboratories, Boston.

The aim of this project was to investigate a new pulsed laser system for the treatment of leg telangiectases. The laser is a semiconductor, diode laser at a wavelength of 800 nm (near infrared) that emits a range of pulse widths from 5 to 30 msec. Pulses are delivered through an optical hand piece which provides refractive index matching, a square output aperture of 9 by 9 mm and cooling of the skin surface to 10°C. This wavelength and pulse width range are new to the treatment of vascular lesions, and the study was designed to evaluate if these parameters are beneficial for the treatment of leg veins.

Only leg telangiectasia without underlying incompetence of the superficial venous system, as assessed by Doppler examination, were included in the study. The leg telangiectases were classified according to clinical appearance (blue or red, linear, arborizing or spider) and vessel diameter. The vessel diameter was measured from computer images, taken with a polarized CCD camera. The sizes varied between <400 μm to 1 mm.

25 subjects were treated at 8 test sites, using varying fluences (20-50J/cm^2) and varying pulse widths 5 to 20 msec. Of the 8 treatment sites, 4 received 1 treatment and the remaining 4, up to three treatments, once a month. The possible additive effect of multiple pulses was also evaluated by treating test sites with triple pulses, given at a repetition rate of 0.5 Hz. Blinded analysis of results was obtained by presentation of polarized photographs of treatment fields to a panel of observers not involved in the study performance.

Substantial clearing of leg veins was obtained . Transient pigment changes were seen. Conclusions based on these preliminary data suggest that the pulsed, 800 nm diode laser is a safe and effective method for removal of leg telangiectasia.

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The Efficacy Of The Coherent Versapulse 532nm variable pulse laser for the treatment of superficial leg telangiectasias.
Vic A Narurkar MD, UC Davis Laser Center

The treatment of leg telangiectasias with lasers poses many challenges including delivery of adequate fluence, optimizing wavelength and pulse duration and reducing unwanted epidermal injury. This study was undertaken to examine the efficacy of a variable pulse

532nm laser with a chilling tip (Coherent Versapulse) for the treatment of leg telangiectasias. Two hundred patients were enrolled in the study. Telangiectasias were divided in the following categories (A) Less than 0.5mm diameter (B)Between 0.5mm to 1mm diameter (C) 1mm- 1.5mm diameter and (D) greater than 1/5mm diameter. (E) Telangiectatic mats. Patients were further divided based on previous treatment with sclerotherapy. Patients with significant reticular or varicose veins were excluded. Patients were evaluated at 6 weeks, 3 months and 6 months post treatment. Before and after photographs and a grading scale were developed for assessment.

Vessels less than 0.5mm diameter showed optimal clearance with one or two treatments. Vessels between 0.5mm - 1.5mm diameter required greater number of treatments. Vessels greater than 1.5mm in diameter did not show good response. Vessels previously treated with sclerotherapy showed better response than untreated vessels. Complications were rare and included blistering transient urtication and erythema and transient hypopigmentation. We conclude that the Versapulse laser is effective for the treatment of small diameter leg veins

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LONG PULSE NORMAL MODE ALEXANDRITE LASER TREATMENT OF LEG VEINS

Robert M. Adrian, Georgetown University Medical School, Center for Laser Surgery, Washington, DC

At the present time a number of laser and intense pulsed light sources are available for the treatment of leg veins. Most current lasers use wavelengths between 532nm and 595nm as the energy source. These wavelengths coincide with absorption peaks for hemoglobin. Recently a new non Q-switched 755nm Alexandrite laser has been introduced for the treatment of leg veins. Expanding on earlier work by Dr. David McDaniel (personal communication) we entered 25 patients with lower extremity telangiectasia in a study in order to assess the safety and efficacy of this wavelength in the treatment of leg telangiectasia. Initial results of this study show that this laser is capable of treating certain lower extremity leg veins.

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REMOVAL OF LEG VEINS WITH LASERSCOPE POTASSIUM TITANYL PHOSPHATE-532 NM AND DERMASTAT 2MM HANDPIECE

AT Quintana, MG Grossman, ANB Kauvar, LJ Bernstein, RG Geronemus
Laser and Skin Surgery Center of New York

The purpose for presenting this study is to evaluate the safety and efficacy of Potassium Titanyl Phosphate Laser (532 nm, 10 ms/15 ms, variable fluence, 2mm spot size) for the treatment of leg veins. Twenty subjects, with small leg veins (<1.5mm) were treated at varying fluences (13-18Jcm/2) and pulse durations (10 and 15 ms) up to four times at four to six week intervals. Clinical assessment and photographic documentation was done at one, three and six months after final treatment.

Results to date are variable. 25-50% clearance has been seen in half the patients treated only once. There has been no scarring. Twenty-five percent have shown transient hyperpigmentation.

The Potassium Titanyl Phosphate-532 nm laser appears to be a safe alternative for treatment of leg telangiectasias.

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TREATMENT OF MATURE STRIAE WITH THE PULSED DYE LASER

Kishwer S. Nehal, Vicki J. Levine, Robin Ashinoff
Department of Dermatology, New York University Medical Center, New York, New York 10016

A single published study has shown improvement in mature striae with increased elastin content following treatment with the pulsed dye laser. The purpose of this study was to determine if the pulsed dye laser is an effective treatment for mature striae. Five patients with mature white striae on the abdomen, hips, and thighs were prospectively treated with the pulsed dye laser. Clinical photographs, surface impressions for optical profilometry, and biopsies of the striae were obtained at baseline and following 2-7 treatments. The follow-up period was 1.5 years. Clinical appearance of the striae was not significantly improved based on physician assessment. Optical profilometry suggested an increase in skin surface markings. Histologic evaluation showed normalization of collagen architecture but no increase in elastic tissue. We conclude that the pulsed dye laser treatment of mature white striae may increase skin surface markings but does not seem to improve clinical appearance or increase elastin content histologically.

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LONG TERM RESULTS OF TREATMENT OF STRETCH MARKS WITH THE 585NM FLASHLAMP-PUMPED PULSED DYE LASER, A FOLLOW-UP STUDY.

K. Ash, A. Kauvar, J. Lord, L. Bernstein, M. Zukowski, R. Geronemus, D. McDaniel. Laser Center of Virginia, Laser & Skin Surgery Center of New York, Eastern Virginia Medical School and Naval Medical Center Portsmouth, Virginia.

This reports a prospective follow-up study to document the long term efficacy of single and multiple treatments of striae distenae alba with the 585nm flashlamp pulsed dye laser. A total of 90 treatment areas (15 patients) were assessed initially and at 6, 12 and 18 weeks following single or multiple treatments. Treatment parameters utilized a 10mm handpiece, at either 3 or 4 J/cm^2. Subjective response to therapy was documented via questionnaire and objectively by serial photography, optical profilometry, blinded photo grading and histologically by serial 2mm punch biopsies initially, and after each subsequent treatment. Subjectively, patients reported 50% improvement for all treatment protocols. Objectively, striae improved with time. Single treatment with 3 J/cm^2 showed 34%, 43%, and 51% at 6, 12 and 18 weeks compared with 4 J/cm^2 showed 41%, 43%, and 52% respectively. Triple treatments (at 6 week intervals) using 3 J/cm^2 showed 34%, 58%, and 73% and with 4 J/cm^2 41%, 62%, and 72%. Profilometric analysis supported this data, but was not sensitive enough to distinguish statistical difference between 3 and 4 J/cm^2. Papillary dermal thickness increased greatest

with the 4 J/cm^2 fluence at 12 weeks post treatment then returned to pretreatment thickness. Collagen and elastin were subjectively assessed via blinded grading and also through digitation and binary scanning of photo micrographs to calculate the increase in elastin surface area (data still being analyzed at abstract submission).

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HAIR REMOVAL BY A PULSED, INFRARED LASER SYSTEM: Christine C. Dierickx, Melanie C.Grossman, William A. Farinelli, Woraphong Manuskiatti, Valeria Duque, David Lin, R. Rox Anderson. Wellman Laboratories, Boston.

The purpose of this study was to evaluate the efficacy and safety of a 800 nm, pulsed diode laser for hair removal (Star Medical). The source can produce fluences up to 40 J/cm^2 and variable pulse widths between 5 and 30 msec. Pulses are delivered through an optical hand piece which provides refractive index matching, a square output aperture of 9 by 9 mm and cooling of the skin surface to 10°C. Cooling raises the tolerated fluence, provides partial anesthesia and spares the epidermis by conduction during laser pulse delivery.

50 subjects were treated at 7 test sites, using varying fluences (20-50J/cm^2) and pulse widths (5 to 20 msec). Additionally, there was a shaved, unexposed control site. Of the 7 sites, 5 received 1 treatment and the remaining 2, a second treatment, 1 month later. The possible additive effect of multiple pulses was also evaluated by treating 2 test sites with triple pulses, given at a repetition rate of 0.5 Hz.

Hair counts were obtained prior to treatment and at 1,3,6 and 9 months post laser treatment using digital images obtained with a CCD camera. Determination of the stage of the hair growth cycle (anagen vs. telogen) was done to study if the hair growth cycle had any influence on the outcome results. Histologic examination will be discussed.

There was a significant hair growth delay in most subjects. The efficacy of 2 treatments was significantly greater than one. There was also apparently permanent hair loss following 2 treatments. Transient pigment changes were seen. There was an absence of scarring. Conclusions based on these preliminary data suggest that the pulsed, 800 nm diode laser is a safe and long lasting method for hair removal.

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COMPARISON BETWEEN A LONG PULSED RUBY LASER AND A PULSED, INFRARED LASER SYSTEM FOR HAIR REMOVAL: Christine C. Dierickx, Melanie C.Grossman, William A. Farinelli, Woraphong Manuskiatti, Valeria Duque, David Lin, R. Rox Anderson. Wellman Laboratories, Boston.

The purpose of this study was to compare the efficacy and safety of a 694 nm, long pulsed ruby laser (Palomar) and a 800 nm, pulsed diode laser for hair removal (Star Medical). The ruby laser has a pulse width of 3 msec and a maximum fluence of 50J/ cm^2. The diode laser has variable pulse widths between 5 and 30 msec with a maximum fluence of 40J/ cm^2. For both sources, pulses are delivered through an optical hand piece which provides refractive index matching and cooling of the skin surface.

20 overlapping patients, enrolled both in a ruby and diode hair removal study, were included in this retrospective comparison. For each laser, test sites exposed to the respectively highest fluences were compared. The possible additive effect of multiple treatments and multiple pulses was also evaluated: test sites that were treated twice at a fixed interval of 1 month month, and test sites that were treated with multiple pulses, given at a repetition rate of 0.5 Hz, were compared. Additionally, there was a shaved, unexposed control site in both studies.

Hair counts were obtained prior to treatment and at 1,3,6 and 9 months post laser treatment using digital images obtained with a CCD camera. Histologic examination will be discussed.

The percentage regrowth at 1 month was significantly higher for the diode laser. However, thelong term efficacy after 2 treatments was significantly greater for the diode laser. This is suggestive that the sensitivity of human hair follicles to laser pulses varies with the hair growth cycle. Transient pigment changes were seen. Conclusions based on these preliminary data suggest that the both lasers are a safe and long lasting method for hair removal.

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Fifteen Month Clinical Trial of Hair Removal With the Alexandrite Laser

Yehuda D. Eliezri, Columbia Presbyterian Medical Center

A fifteen month trial with 175 patients seeking hair removal at various anatomic sites and treated with the high repetition rate pulsed Sharplan Epitouch Alexandrite laser (755nm). Treatment was administered with a 7 millimeter spot size and pulse duration of 2 milliseconds at an energy fluence on the skin of 25 joules per square centimeter. Pre-treatment preparation included only short cropping of the hair and the topical application of a transparent gel to cool the skin. All patients underwent repeated (3-6) treatments as hair was seen to grow. Hair counts were performed before the study, and at least three months after the treatment.

Results:

All patients saw improvement in hair counts at the end of the study: Upper lip 90%, sideburns 95%, chin 85%, bikini line 90%. Rare undesirable effects included: light erythema lasting 1-3 days, superficial blister formation, mainly on the bikini line, and transient pigment alteration. All these effects resolved completely. Best candidates for the treatment were patients with pale complexion and darker hair color.

Conclusion:

The advantages of this laser method for hair removal are: more rapid pulsed laser emission capabilities (up to 5 pulses per second) facilitating coverage of large areas per session, no need for the application of pigments topical gels, and encouraging hair removal with minimal undesirable effects.

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REMOVAL OF EXCESS BODY HAIR WITH AN 800 NM PULSED DIODE LASER

M. Grossman[1], C. Dierickx[2], A. Quintana[1], R. Geronemus[1], R. Anderson[2].

Laser and Skin Surgery Center of New York[1]

Massachusetts General Hospital[2]

The purpose of this study was to evaluate the safety and efficacy of a diode laser (800 nm, 9x9 mm spot size, variable pulse duration-5-20 ms, variable fluence 15-40 J/cm^2, cooling handpiece) for the removal of excess body hair.

One hundred subjects type I-IV underwent test site treatments. After determining the highest tolerated fluence for each subject, a treatment was done at a chosen area. Treatment sites included the face, trunk and extremities. Fluences ranged between 15 and 40 J/cm^2. Each subject received up to three treatments per site. Hair regrowth was assessed one, three and six months after the final treatment.

Follow up data available at the time of writing this abstract show a growth delay in most subjects. Transient pigmentation changes

were seen in less then 10% of the subjects. There was an absence of scarring.
Conclusions based on this preliminary data suggest that the laser diode is a safe effective method for removing body hair of the face, trunk and extremities.

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TOPICAL SUSPENSION ASSISTED Q-SWITCHED ND: YAG LASER HAIR REMOVAL: EVALUATION OF A MODIFIED TECHNIQUE

Curt M. Littler, Scripps Clinic and Research Foundation

The purpose of the study was to evaluate a modified method of topical carbon suspension assisted Q-Switched Nd: YAG laser hair removal. Volunteers with increased body hair were recruited. Selected areas were treated with the Q-Switched Nd: YAG laser at 1064nm, 10-20 nsec, 7mm spot, 2.5J/cm2 or less. The modified technique involves using low fluence (~1.2J/cm2) for carbon propulsion into the follicle, lasing through a hydrogel, using a smaller carbon particle suspension and no waxing. The standard procedure employs waxing and lasing with 2.5J/cm2 after larger particle carbon suspension application. The modified technique demonstrates more consistent carbon propulsion deep into the follicle and more histologic follicular damage. Side effects of mild erythema and edema lasted for less than one hour in most cases. No permanent pigmentary changes, tattooing or scarring were noted. The modified technique using the Q-Switched Nd: YAG laser with a topical carbon suspension appears to be a safe and more effective method for laser hair damage. Adverse effects were minimal and transient.

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HAIR REMOVAL STUDY COMPARING THE Q-SWITCHED Nd:YAG AND LONG PULSE RUBY & ALEXANDRITE LASERS.

Suzanne L. Kilmer , Vera. Chotzen, and Jacqueline Calkin. Laser and Skin Surgery Center of Northern California, Sacramento, CA.

Several laser hair removal systems are now FDA approved. The purpose of this study is to compare the efficacy and safety of three distinct laser hair removal systems: a Q-switched Nd:YAG laser (1064 nanometers, 4 mm spot size, 10 J/cm2) (Polytec PI, Auburn, MA, and Continuum Biomedical, Dublin, CA), a long pulse ruby laser (10 mm/18-50 J/cm2) (Epilaser, Palomar, Lexington, MA), and a long pulse alexandrite laser (10 mm/18-24J/cm2) (Cynosure, Chelmsford, MA). Twenty patients (17 women, 3 men) were consented, and the treatment area was divided into quadrants, photographed, and shaved. Three of the quadrants were treated, each with a different laser. The fourth quadrant was not treated and served as a control. Patients were instructed to return when new hair growth was noted and were treated in the same manner at that time. Up to three treatment sessions were performed. Grading of hair reduction in density was done by the patient and physician at each visit. For the alexandrite, ruby, and YAG laser, a median reduction in hair density was noted to be 60%, 60%, 40% respectively after their first treatment and 70%, 80%, 60% after the second treatment. Longer term data will be presented but, in general, patients are pleased with the amount of hair reduction achieved. The mechanism for hair removal, similar to other laser modalities, utilizes the various wavelengths' affinity for pigmented hair. Histological examination shows that all three lasers target melanin and cause disruption of the hair follicles. The shorter wavelengths have more melanin absorption targeting the hair follicle but are more injurious to the epidermis. The cooling device on the long pulse ruby laser allows safe treatment of hair, but blistering, and possible hyperpigmentation, is still a risk with darker skin types. The long pulse alexandrite is theoretically less traumatic to the epidermis but may be less effective for lighter hairs. The YAG laser is least effective, especially with lighter hair, but has the least risk for dyspigmentation. Final results will help address long-term efficacy.

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HISTOLOCICAL RESULTS OF LONG-PULSED RUBY LASER TREATMENT OF HAIR FOLLICLES - A TWO MONTH STUDY.

Sue McCoy , Anne Evans
Laser, Skin and Vein Clinic, North Adelaide, South Australia

In attempt to ascertain a) whether a photonic energy-hair follicle interaction occurs which should result in the permanent eradication of that hair and b) whether at energies necessary to achieve this objective there is other non-specific epidermal or dermal damage, we have performed a limited histologic analysis of ruby laser-irradiated hairy skin.
The laser was a Spectrum ruby laser (Epilaser®) emitting light at 694nm in pulses of 3 milliseconds at pulse intervals of 2 sec. The spot sizes used were 7 and 10mm depending on the energy selected. The sapphire handpiece, cooled to 4° C, was pressed against the skin for approx 0.5 sec prior to laser irradiation, and adjacent spots were overlapped by about 30%.
Phase 1. Fifteen informed consenting volunteers with untanned Fitzpatrick skin types I to III were initially treated. The test treatment areas had not had hair removed by any method other than shaving for at least 4 weeks prior to the study.
Areas treated, either the groin or the axilla, were outlined with a red marker, photographed and then shaved. Each test area was treated with 5 different fluences - 10, 15, 20, 30 and 40 J/cm^2 . From each patient one biopsy was taken, either immediately after treatment, one week later or 4 weeks later (therefore each fluence at each post-treatment interval was sampled). Biopsies taken immediately after treatment were snap frozen and prepared for NitroblueTetrazolium Chloride enzyme stain to detect the vital enzyme nicotinamide adenine dinucleotide diaphorase thus determining cell viability. Biopsies at one and 4 weeks were routinely fixed in formalin for H&E staining. The pathologist examining the biopsies was blinded to the fluence used.
Phase 2. Three additional patients were treated at 20, 30 and 40 J/cm^2 biopsied 2 months later (one biopsy of each fluence).
At all fluences but with increasing severity there was evidence of selective damage to the inner root sheaths, progressing to the matrix of the bulb but sparing the papilla. At one week the damaged hair shaft was evident with some necrosis of keratinocytes in the upper shaft. Higher energies appeared to have induced early catagen-like changes. At one month most follicles were in late catagen/early telogen, with higher energies inducing more advanced catagen rather than more severe follicle damage. However, at two months there was little residual evidence of follicle damage. All biopsies contained normal-looking anagen hairs with no sign of residual fibrous tracts or ongoing degeneration of irreversibly damaged follicles. Clinically there was almost complete regrowth of hair. No specimens at any stage showed any significant injury to the epidermis or other skin appendages.
We conclude that this method of hair removal is not permanent in the axilla or groin after only one treatment regardless of fluence used.

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LONG-TERM RESULTS OF HAIR PHOTO-EPILATION.

Stacy R. Smith, Yardy Tse, Sandra K. Adsit, Mitchel P. Goldman, Richard E. Fitzpatrick, San Diego, CA

Purpose: The purpose of this study was to evaluate the efficacy of hair removal using the ESC Epilight Hair Removal System.
Method: 90 patients with skin types I-V and light brown to black hair were treated with the Epilight System at 185 sites. A total of four treatments were given at biweekly intervals. Wavelengths of 590, 615, 645 and 695 with fluences of 33-60 J/cm2 delivered over two to five pulses lasting 2.5 to 3.5 msec were used. Photographs and hair counts were taken pretreatment, after each treatment, and monthly for 6 months.
Results: 81% of hair was removed after the third treatment. Four months after treatment, 63% of hair remained epilated. At

the six month follow-up, 48% of hair had regrown. Adverse effects were transient and included hyper and hypopigmentation and blistering.
Conclusions: The Epilight Hair Removal System is a safe and effective method of epilation. Further studies are underway to determine if additional treatments with longer treatment intervals would be even more effective in long-term hair removal.

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Photoderm VL™ Hair Removal.
B.D. Zelickson M.D. and M Flor R.N.
Skin Specialists, Ltd and Abbott Northwestern Hospital, Mpls. MN
Background: Lasers selectively tuned to target melanin have been shown to be effective at removing pigmented hair. The Photoderm VL™ high energy light source has previously been shown to be able to lighted pigmented lesions.
Objective: The present study evaluated the clinical effects of Photoderm VL™ treatment of unwanted body hair.
Methods: Eighty-three volunteers were selected and given a test patch with the Photoderm VL™ using two settings (570 filter, 2.4 ms / 2.4 ms pulse duration with a 10 ms delay, at 35 - 46 J and 590 filter, 3.1ms / 3.1 ms pulse duration with a 20 ms delay, at 42 - 47 J). The volunteers returned at 4 weeks for hair counts. The settings with the greatest reduction in hair counts were then used to treat the designated area every 4 - 6 weeks for up to 5 treatments. The volunteers returned for follow-up hair counts for up to 16 weeks.
Results: Fifty-nine female, twelve male, and twelve transgender volunteers were treated. All had skin type I - III. Overall, there was approximately 60 %, 45 % and 40% reduction in hair counts at 4, 8, and over 12 weeks follow-up respectively. In general more treatments lead to a greater reduction in counts and there was no clear distinction to percent reduction and body location in this small sample size. Three subjects showed hypo- and hyperpigmentation from treatment. Longer follow-up will be presented.
Conclusions: The Photoderm VL™ can be used to successfully remove and delay the growth of dark hairs in light skinned individuals with little risk of adverse effects. Longer follow-up time and further evaluation of different Photoderm VL™ parameters are needed to optimize therapy.

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CO2 Versus Erbium Laser Assisted Hair Transplantation
Marc R. Avram
New York, New York

The CO2 laser has been an effective instrument in hair restoration surgery. Its main limitation has been the amount of peripheral dermal necrosis at the recipient sites limiting the ability to create closely spaced sites resulting in decreased density. The highly selective nature of the erbium-YAG laser offers the potential to overcome the limitation of the CO2 laser.

Twenty biopsies of erbium and CO2 laser created sites were performed and compared for the amount of peripheral dermal necrosis. Based on pathology, optimal laser parameter were determined.

The amount of peripheral necrosis at erbium laser sites varied from 5-10 microns and CO2 laser assisted sites varied from 50-90 microns.

The post operative healing time of each laser is comparable. There were no post operative complications in any patient.

The amount of peripheral necrosis at erbium-yag created recipient sites is significantly reduced compared to the CO2 laser. The erbium laser offers the potential to create recipient sites as close as steel trephines while maintaining the advantages of a laser with excellent hemostasis and reduced operating time.

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ERBIUM:YAG LASER-ASSISTED HAIR TRANSPLANTATION: A CLINICAL AND HISTOLOGIC STUDY. Albert J.Nemeth, Iain Miller*, L.Frank Glass, Jane L. Messina, Robert D. Rehnke, Clearwater, Tampa, St. Petersburg, FL and Boston, MA*.
The major potential drawbacks of conventional slit grafts are compression and decreased hair density with comparable donor material since bald tissue is not removed. Carbon dioxide lasers introduced additional drawbacks: Thermal damage impairing graft revascularization, increased inflammation, poor "take" and "yield", and scarring. Since the Erbium:YAG(Er:YAG) laser addresses these potential drawbacks, we evaluated the histologic and clinical effects of the Er:YAG laser (Candela/Fotona) for hair transplantation. Scalp obtained from rhytidectomy was subjected to Er:YAG laser energies from 260-1000mJ, pulse durations of 250-500μs, and pulse repetition rates of 5-15Hz with a 1 mm spot size. A total of 35 Er:YAG laser created scalp recipient site specimens were evaluated by two "blinded" dermatopathologists. Consistently and reproducibly the lower reticular dermis near the fat and the fat i.e. the level at which transplanted hair follicles reside, exhibited no or less than 10 microns of thermal damage. Twelve male patients with male pattern alopecia (ages 26-63) underwent hair transplantation with micro and minigrafting with 1419 recipient sites created by Er:YAG laser alone and in combination with 1934 16G Nokor created slit recipient sites. Parameters used to create the Erbium recipient sites were similar to the above parameters. Since the Er:YAG offered the flexibility of site shape, both slits and round sites were created. Bleeding from the Er:YAG laser recipient sites was not a clinical problem and easily controlled with tumescent local anaesthesia. Patients have been followed for 4 - 14 months (Mean: 9.3). Crusting was prolonged by an average 5 days and the onset of hair growth was delayed by up to 3 weeks when higher energies and pulse repetition rates were used, and initially when the recipient sites were made freehand without the laser in a preset duration of exposure. Graft "yield" and "take" were comparable to conventional slits. There was no evidence of transplant compression resulting in transplants virtually indistinguishable from normal hair. Hair density was greater in Er:YAG prepared areas. Er:YAG sites took longer to create, but speed increased with procedure familiarity. No scarring was noted. We conclude that the Er:YAG laser is capable of creating hair transplant recipient sites with precision and a paucity of concomitant thermal damage at the level at which transplanted hair follicles reside. The Er:YAG laser represents an important tool in the hair transplant armamentarium.

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RESULTS OF PATIENTS TREATED FOR POIKILODERMA OF CIVATTE WITH THE FLASHLAMP-PUMPED PULSED DYE LASER (AT 585 nm). S McCoy, JM Grevelink, Laser Skin & Vein Clinic, North Adelaide, SA and Dermatology Laser Center, Massachusetts General Hospital, Boston, MA.

Current literature supports the use of the flashlamp-pumped pulsed dye laser for the treatment of poikiloderma of Civatte with virtually no adverse effects such as atrophy, textural changes, hypopigmentation or scarring. This retrospective study provides an analysis

of post-treatment complications and follow-up of 20 patients over four years. Results indicate that contrary to these established references, all of the above-mentioned conditions were encountered in a majority of patients treated with the flashlamp-pumped pulsed dye laser even at low to moderately-low fluences. Although slight improvement was obtained in some patients, hypopigmentation and scarring were common. Hyperpigmentation was in most instances transient, but permanent hypo- and depigmentation were observed in a majority of patients. This undesirable response to laser treatment might be caused by mechanisms responsible for photodamage and poikiloderma or they might simply reflect the delicate nature of neck and chest skin or a combination of both. It appears that the treatment of poikiloderma in the neck and chest area should be approached with great caution.

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Comparision of variable pulse width and wavelength pulsed dye laser with the variable pulse with 532nm laser for the treatment of facial vascular lesions

Vic Narurkar MD, Ann Haas MD, UC Davis Laser Center

Selective destruction of vascular lesions involves optimizing wavelength and pulse duration. This study was undertaken to compare different pulse durations and wavelengths for the treatment of facial vascular lesions on the same patient. Fifty patients with facial telangiectasias, spider angiomas, and other vascular proliferative lesions were treated with the pulsed dye laser at 585nm, 590nm, 595nm and 600nm with pulse durations at 450usec and 1.5 msec (Cynosure VLS laser) and the variable pulse duration 532nm laser (Coherent Versapulse laser)

Parameters examined included endpoints of treatment,number of treatments, patient comfort, post-operative healing and final outcome. The majority of facial vascular lesions showed equivalent outcome. Advantages of the pulsed dye laser included ease of operation, more predictable endpoint and speed. Advantages of the Versapulse laser included lack of purpura, greater patient comfort and reduced post-operative recovery time. We conclude that variable pulse 532nm and variable pulse and wavelength FPDL are highly selective modalities for treating facial vascular lesions

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THE EFFECTS OF CRYOGEN SPRAY COOLING ON PULSED DYE LASER TREATMENT OF VASCULAR LESIONS

Kauvar, ANB, Grossman, MC, Bernstein, LJ, Kovacs, SO, Quintana, AT, Geronemus RG
Laser and Skin Surgery Center of New York

Millisecond cryogen spurts immediately prior to laser irradiation can rapidly reduce the epidermal surface temperature to the range of 30°-40° C, thereby reducing treatment discomfort and protecting the epidermis form thermal injury during pulsed dye laser treatment. The purpose of this presentation is to discuss the effects of cryogen spray cooling used in conjunction with pulsed dye laser treatment for a variety of vascular lesions, including port wine stains, hemangiomas, telangiectases and leg veins.

Patients with port wine stains, hemangiomas and telangiectases were treated with a flashlamp-pumped pulsed dye laser at a wavelength of 595 nm and a pulse duration of 1.5 msec. In each patient, selective lesion sites were treated with and without cold cryogen spurts ranging between 20-50 msec in duration and delivered 20-50 msec immediately prior to laser irradiation.

The ability of cryogen spray cooling to protect the epidermis (with regard to the development of post-treatment erythema and pigmentary change), reduce intra-operative discomfort and allow for the safe utilization of significantly higher fluences, and its effects on treatment efficacy will be discussed.

The optimal treatment parameters for cryogen spray cooling in conjunction with pulsed dye laser treatment of vascular lesions are presented.

Cryogen spray cooling has enabled pain-free treatment of vascular lesions which is particularly beneficial for treating vascular birthmarks in pediatric patients. Other potential advantages of skin cooling, including epidermal protection and the ability to use higher treatment fluences are explored.

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LONG-PULSED 532nm LASER TREATMENT OF FACIAL TELANGIECTASIAS

Emil A. Tanghetti, M.D., Robert M. Adrian, M.D., Center for Laser Surgery, Sacramento, CA, Washington, D.C.

Facial Telangiectasias are a frequently observed cosmetic concern. We treated 100 patients with facial telangiectasias ranging from .2-1.5mm with a new long-pulsed 532nm Nd:YAG laser (Versapulse^R, Coherent Medical, Palo Alto, CA). Fluences of 9.0-12J/cm^2 with a 4mm spot, a 10msec. pulse, and a water-cooled chill tip at 4-5.5° C were used. Vessels were treated with 1-4 passes to disappearance or a persistent purple discoloration indicating intravascular thrombosis. 80% of patients achieved 75-100% clearance of their facial telangiectasias after one treatment. 95% of patients achieved this clearance after a second treatment. Patients experienced minimal pain. Transient and mild swelling and erythema were noted after the procedure. These clinical results were achieved without the unwanted purpura associated with pulsed-dye laser treatments. The unique chill tip allows the thermal injury to remain relatively confined to the abnormal vessels and permits the delivery of multiple low-peak temperature heating cycles. The Versapulse^R laser is an effective tool in the treatment of facial telangiectasias.

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Treatment of individual cafe au lait macules with Q-Switched YAG and Q-Switched Ruby : a clinopathologic correlation

J.L. Levy, M. Pizzi-Anselme, S. Mordon
Dermatology Laser Center Marseille, Inserm U279 ,University hospital, Lille, France

Cafe au lait macules (CALMs) respond variably to treatment with lasers. This study was done to identify which individual features of

CALMs could predict a good clinical response to treatment.
22 patients aged 3 years to 43 years were treated with the frequency-doubled Q-Switched Nd :YAG (QSY,532nm, 10ns, Ø = 3 mm) or the Q-Switched Ruby laser (QSR,694nm, 25ns, Ø = 3 mm). QSY lasers were used at a fluence of 3.0J/cm2, QSR lasers were used at a fluence of 8.0J/cm2. Biopsy specimens of the CALMs were obtained before treatment in 13 patients to achieve the diagnosis of CALMs. Since, CALMs usually need several laser sessions, interval laser treatment was 2 months. Clinical follow-up was done 3, 6 and 12 months after last treatment to observe results and recurrences .
Good results are obtained with both lasers even with high fluence. The color is not a determinant factor. However, the better response is obtained in CALMs, in young patients (skin type I or II) with CALMs showing borders with a jagged aspect, never exposed to sun.
Histology confirms the diagnostic but does not predict clinical outcome after laser treatment.

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REFINEMENT IN THE LASER TREATMENT OF CONGENITAL PIGMENTED NEVI

Ken-ichiro Kasai, Aya Hisano, Megumi Sakai
Yotsubashi Laser Institute, Kasai Clinic for Plastic Surgery, Osaka, JAPAN

Last year, we proposed a new protocol for treating congenital pigmented nevi as follows (Osaka Procedure); <1>non-Q-switched Ruby until 50% clearance (usually 3-5 times) <2>Alexandrite until 75% clearance (usually 2-4 times) <3>Q-switched Nd:YAG touch-up (usually 2-4 times) <4>ultrapulse CO2 resurfacing and electric epilation (optional). This serial combined laser treatment enabled complete clearance of large pigmented nevi without excisional surgery. This time, we introduce several refinements in clinical practice for this laser treatment of congenital pigmented nevi.

(1) Remodeling of the lasers The fluence of non-Q-switched Ruby should be increased treatment by treatment, up to 60 J/cm2, which can be achieved by remodeling the lasers on the market. High fluence is essential to clear the thick black pigment of the nevi. For the same reason, the fluence of Alexandrite laser should be increased up to 30 J/cm2.
(2) Focusing the laser beam When exposing dotted pigmented spots on one nevus, the laser beam should be focused down smaller to adjust each spot of the nevus. This operation is rather tedious to do, but is essential to avoid thermal damage to the surrounding normal tissues. Also, we are using hand-made holed paper as an iris.
(3) Timing of the electric epilation The hairs of the nevi can be thinned as laser treatment proceed, but often remain even after repeated laser treatment. Previously, we performed electric epilation after completion of the laser treatment. Now we do it just before each laser treatment. This reduced the number of the treatment sessions, and, furthermore, lessened the follicular recurrence of the pigment.

PLENARY SESSION

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WHAT IS THE CURRENT ROLE OF LASERS IN CARDIOLOGY?

On Topaz, M.D., FACC. Division of Cardiology, Virginia Commonwealth University/Medical College of Virginia Hospitals and Hunter Holmes McGuire VA Medical Center, Richmond, Virginia. USA

Over the last two years a growing interest in application of laser in cardiovascular medicine has been developed. At present, several wave-length laser (excimer, CO_2, holmium:YAG) are utilized for the following: (1) TMR: Transmyocardial Revascularization of ischemic myocardium, a procedure considered highly controversial. (2) Pacemaker leads extraction. (3) Thrombolysis: clot lysis in acute myocardial infarction. (4) Complex coronary and saphenous vein grafts lesions not suitable for other treatment modalities and (5) In-stent restenosis: reopening of obstructed coronary stents. The data and an objective assessment of each of these indications will be presented.

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LASERS IN DENTISTRY Harvey Wigdor Ravenswood Hospital Medical Center, Chicago, Illinois & Northwestern University Department of Biomedical Engineering, Evanston, Illinois.

Ever since the development of the ruby laser in 1961 there has been great interest in the possible use of lasers in dentistry. The early researchers looked at the possible use of lasers to effect the surface of enamel reducing acid demineralization of enamel. The obvious potential use is for the laser is to replace the dental drill(handpiece). Recently the Food and Drug Administration cleared the Er:YAG laser for use in dentistry to remove decay and take the place of the dental handpiece. This laser has some limitations including inability to cut enamel efficiently, increased time to prepare the tooth for restoration and limited use in the preparation of teeth for crowns and more extensive restorations. In the typical dental practice the number of procedures for which the laser can be used is very limited.
Er:YAG research has been performed by the author and will summarize the results. These include thermal effects on enamel, dentin and dental materials. It seems that this laser may have some potential in dentistry. However efficient parameters must be developed which will allow the laser to cut both dental hard tissues and materials for the laser to be accepted by the dental profession.
A survey published recently on the patients' perception of lasers reveals that over 65% of dental patients feel that a laser would make their visit to the dentist easier.